AD 295 103

PROGRESS REPORT

ON

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"DESIGN CRITERIA FOR RADIATION RESISTANT

FLIGHT CONTROL SYSTEMS FOR AEROSPACE VEHICLES"

Period Covered: 1 July — 31 July 1962

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1. Technical Areas

The description of technical effort will be divided into the five areas of major effort for this period.

A. Definition of the Radiative Environment

The radiation environment exterior to a vehicle has been specified for four mission profiles. An extension of this environment specification is now in progress; however, only the methodology is being derived, since state-of-the-art in environment definition is not sufficiently well advanced at this time. The method involves using spectral information derived from satellites and transforming it into latitude-radial distance graphs. Then by using descriptive geometry techniques, the intersection of the mission with areas of equal flux can be determined. From this an application of Kepler's laws of planetary motion or trajectory programs provide the necessary information to perform a time integration of the radiation flux along the trajectory.

B. Determination of Radiation Penetration Through the Satellite Walls

The penetration of solar high energy particles has been determined for two solar events. First, the solar event of 28 September 1961 has been integrated with respect to time. This flare, although of relatively low intensity, was detected outside the influence of the earth's magnetic field for the entire time period of the event. Fourteen times were utilized to obtain the intensity-time history of the event as the basis for integrating with respect to time. Then in order to calculate the dose from flares, the flare was normalized to 1 proton/cm^2 ster having E > 100 Mev. The normalized flux has been input to the Proton Shielding Program to obtain the carbon dose after penetrating .04" aluminum for flares outside the earth's magnetic field.

In addition to the 28 September 1961 flare, the model solar flare of D. K. Bailey (Figure 33, NSL 62-80) has been time-integrated as to dose and is currently being time-integrated as to flux on the IBM 7090. This flare has been utilized by H. J. Schaefer of the U. S. Naval School of Aviation Medicine and by W. L. Gill of the NASA Manned Spacecraft Center as a typical flare. In this study the normalized time-integrated differential flux will be used with an assumed low energy cutoff due to the earth's magnetic field to determine the carbon dose after penetrating the .04" aluminum.

The doses per particle/cm^2 ster having E > 100 Mev for the above flares will be added to the Van Allen dose for the four specified missions. These results along with a description of the analytical methods are being included in a report to be forwarded under separate cover.

C. Determination of Radiation Damage Criteria

The implications of damage correlation for organic materials have been investigated, and are being coordinated with the radiation dose inside the vehicle as determined from Phase B above. A preliminary of the write-up on state-of-the-art in inorganic correlation has been done. Modification to the write-up will be made as soon as additional data on proton irradiation of transistors is received from Dr. Gardner of Litton Systems, and Mr. Hulten of NASA. Integration of the damage thresholds with correlation considerations will complete the work in this area.

D. Radiation Effects on the System

The determination of radiation effects is being accomplished by integration of the environment specification and correlation studies, including damage thresholds. It is not possible to analyze the exact performance

of a general system, given the damage thresholds for component parameter changes. This might be possible for a very specific small system, but would even then involve a major study. The list of thresholds themselves are the effects of the radiation upon the components; it is meaningless to try to say at this time how a system will perform under integration of all the parameter changes. Some discussion will be given to minimizing the effects of radiation, such as "hardening" techniques.

E. Test Analysis

An experimental program for extending and verifying the aspects of space radiation damage to materials and components is under investigation. Test philosophy can be discussed in three areas:

- testing under proton and electron irradiation using accelerators
- testing under reactor environments and correlating experiments to facilitate the use of reactor data and possibly existing reactor data
- testing under actual proton and electron irradiation in space

Some preliminary thinking on the last two items have been forwarded to P. Polishuk at ASD under separate letter.